Remarks:

This amendment is submitted in an earnest effort to advance this case to issue without delay.

The specification has been gone over to eliminate some minor obvious errors. No new matter whatsoever has been added. Also enclosed herewith is an Abstract of the Disclosure, on a separate sheet. Also enclosed is a PTO-1449 for the references filed earlier

Rather than mark up the file copy of the claims, disassemble the file, copy the marked-up pages, reassemble the file, and attach the copies to the amendment, this amendment replaces the claims with a wholly new set.

Applicant herewith elects the apparatus of canceled claim 16. New main claim 17 is the equivalent of original claims 8 and 16, reading on the apparatus having a blade with a particular type of hardening. This new main claim recites the application of the blade in a manner having patentable weight, here saying it is for use in a machine for cutting a paper or cardboard web or a plastic or metal foil. Dependent claims 18 through 24 correspond closely to original claims 9 through 15, with dependencies corrected and some minor changes in claim language. The error - "smaller"

instead of "greater" - in claim 15 has been corrected in new equivalent claim 24, for instance.

The claims define over the cited art for two main reasons:

1. The main reference, US patent 5,423,240 of DeTorre relates for a machine for cutting tire cord, not the products recited in the new main claim. Thus this reference is excluded by the current claim language and largely irrelevant.

2. Neither DeTorre nor either of the two secondary references - 4,854,204 of Faltin and 4,977,807 of Kai - describes or mentions a plasma-aided hardening of a cutting edge to the claimed depth. In fact the word "plasma" does not appear in any of these references so there is no hint whatsoever in the art with regard to this critical feature of the invention.

Since a feature defined in the claims is neither seen in nor suggested by the cited references, a rejection under §102 or §103 on these references is impossible. Allowance of all claims is in order.

If only minor problems that could be corrected by means of a telephone conference stand in the way of allowance of this

case, the examiner is invited to call the undersigned to make the necessary corrections.

Respectfully submitted,
The Firm of Karl F. Ross P.C.

by: Andrew Wilford, 26,597
Attorney for Applicant

08 November 2002
5676 Riverdale Avenue Box 900
Bronx, NY 10471-0900
Cust. No.: 535
Tel: (718) 884-6600
Fax: (718) 601-1099

Enclosures:

Substitute Specification
Abstract of the Disclosure
Small-scale copy of marked text
PTO-1449.

ABSTRACT OF THE DISCLOSURE

An apparatus for longitudinally cutting a moving material web, in particular a paper or cardboard web or a plastic or metal foil has one or more pairs of circular blades at least one of which has a blade body that has a steel cutting edge. At least a surface of the cutting edge is coated by a plasma-aided method with foreign ions to a depth between 50 μm and 500 μm.

DESCRIPTION

Blade for Cutting a Moving Material Web

FIELD OF THE INVENTION

The invention relates to a blade for cutting a moving material web, in particular for cutting paper or cardboard webs or plastic or metal foils.

~~STATE~~ OF THE ~~ART~~

In treatment machines for paper or cardboard webs or plastic or metal foils different types of blades are used in order to cut the moving webs longitudinally or transversely. Thus roll-cutting machines for paper or cardboard webs or plastic foils normally have a longitudinal-cutting device with several pairs of circular blades that each cut a strip out longitudinally. Thus a wide material web is cut into smaller strips that are subsequently wound up on rolls. Transverse cutting machines to make individual sheets from a material web have in addition to a longitudinal cutting device a transverse cutting device that typically is formed of two cutting drums that each have a surface equipped with one or more transverse blades extending over the length of the drum.

The pairs of circular blades of longitudinal cutting devices each have a cup-shaped blade supporting the web during

bombardment of surfaces with energy-rich ions of chemical elements imbeds these in the surfaces of these materials.

~~SUMMARY~~ OF THE INVENTION

It is an object of the invention to provide a blade for cutting moving material webs that is inexpensive to manufacture but has a long service life even when cutting abrasive paper or cardboard webs.

This object is achieved ~~by the features of claim 1.~~

According to the invention a blade body has a steel cutting edge. At least a surface of the cutting edge is coated by means of a plasma-aided CPVD method with foreign ions to a depth between 50 µm and 500 µm, preferably 100 µm to 200 µm. This dosing with foreign ions in the metal lattice optimally improves hardness for cutting without making the steel too brittle or influencing its ductility. Preferably, ~~as described in claim 2,~~ foreign ions are layered such that at least the cutting edge has a hardness of 800 HV to 1300 HV, preferably 900 HV to 1200 HV, in particular 950 HV to 1050 HV. According to the invention circular blades with such a hardness have a service life in longitudinal cutting devices that is increased by a multiple without the cutting edges failing under stress. Such blades can cut with great accuracy.

cutting and a piercing blade engaged into the web with the cutting edges held in an exact desired cut position. Typically the lower cup-shaped blade is driven while the disk-shaped piercing blade is positioned above it and is freely rotatable (German 3,419,843).

Normally the circular blades in longitudinal cutting devices and the transverse blades in transverse cutting devices are made of steel. They are subject when cutting to substantial wear and thus must be resharpened or replaced at regular intervals. In order to get a clean cut it is necessary to exactly position the blades and maintain this position.

In order to increase the service life of the blades it is known from EP 0,297,399 to make the cutting edges from a hard metal. The application of one or more layers of a hard material to a strip blade is described in EP 0,327,530. A moderately alloyed preferably not stainless steel but rather carbon steel blade is provided at its edge by means of a pulsed CPVD method with a hard layer of nitride, carbide, and/or oxide, carbon nitride and/or oxicarbonitride of the elements of Groups IVb, Vb, or VIB of the periodic table or a nitride of boron, aluminum, silicon, molybdenum, tungsten, or a titanium carbonitride and/or titanium nitride.

The technical procedure of ion implantation for reducing wear of steel is described in the brochure "Plasma-aided Method of Surface Treatment" of the organization Plasmaoberflächen-Technology of the German Gesellschaft für Galvano- und Oberflächentechnik e. V. of Horionsplatz 6, D-40213 Dusseldorf. With ion implantation

Particularly suitable is coating with nitrogen, carbon, molybdenum, tungsten, and/or titanium in variable quantities per mole of steel. The portion of foreign ions that are molybdenum or tungsten ions is smaller than the portion that is titanium ions.

The steel at least for the cutting edge and preferably for the entire blade body is preferably a heat-treated steel, preferably a rolled steel, a high-speed steel, or tool steel, in particular a cold-worked steel, for example a high-alloy chromium-vanadium steel.

BRIEF DESCRIPTION OF THE DRAWING

The drawing serves for describing the invention by means of a simplified illustrated embodiment. ~~FIG. 1~~ is a section through a pair of circular cutters of a longitudinal cutting device for cutting paper or cardboard webs.

~~EMBODIMENT~~ OF THE INVENTION

The pair of circular blades includes as upper blade 1 a disk-shaped circular blade and as lower blade 2 a cup-shaped circular blade. Such blade shapes are described for example in German 3,419,843 or EP 0,297,399.

The upper blade 1 has a disk-shaped blade body 3 with a central hole 4 that is fitted to a bearing on a blade shaft and

secured thereto. The blade body 3 has a frustoconical outer ~~edge~~ surface that forms a sharp cutting edge 5.

The lower blade 2 has a cup-shaped blade body 6 that also has a central hole 7 through which passes a shaft of a longitudinal cutting device. A cutting edge 8 of the cup-shaped lower blade 2 is formed at a radial outer edge of a cylindrical part 9 of the blade body 6 that is bent off perpendicular to the hole 7 and parallel to ~~the blade~~ an imaginary shaft axis of the blade 2.

At least in the region of the cutting edges 5 and 8 of the blades 1 and 2 and preferably the entire blade bodies 3 and 6 including the cutting edges 5 and 8 are of steel. Preferably a worked steel, a roller-bearing steel, a high-speed steel, or a tool steel is used that is subsequently treated in the below-described manner. Circular blades for longitudinally cutting paper or cardboard webs are ideally made starting from a cold-worked tool steel, in particular a high-alloy chromium-vanadium steel.

After making the basic shape of the blade bodies 3 and 6 at least the cutting edges 5 and 8 and preferably the entire blade bodies 3 and 6 are treated by means of a plasma-aided method by ion implantation so that foreign ions are implanted from outside in the outer regions of the metal lattice. Dosing with foreign ions is done such that foreign ions penetrate to a depth of 50 µm to 500 µm, preferably 100 µm to 200 µm. The foreign ions are nitrogen, carbon, molybdenum, tungsten and/or titanium ions. Preferably the proportion of molybdenum or tungsten ions is greater than the proportion of titanium ions.

The type of foreign ion, the treatment temperature, and the treatment time of the pulsed plasma are set such that at least the cutting edges 5 and 8 and preferably the entire blade bodies 3 and 6 attain a Vickers hardness of 800 HV to 1300 HV, preferably 900 HV to 1200 HV. For circular blades for longitudinal cutting a hardness of 950 HV to 1050 HV is particularly suitable. The treatment temperature in the plasma during treatment attains 180°C to 350°C, preferably 220°C to 280°C.

PATENT CLAIMS

1. A blade for cutting a moving material web with a blade body that has a steel cutting edge, characterized in that at least a surface of the cutting edge is coated by means of a plasma-aided method with foreign ions to a depth between 50 µm and 500 µm, preferably 100 µm to 200 µm.

2. The blade according to claim 1, characterized in that at least the cutting edge (5 or 8) has a hardness of 800 HV to 1300 HV, preferably 900 HV to 1200 HV, in particular 950 HV to 1050 HV, without impairing ductility.

3. The blade according to claim 1 or 2, characterized in that at least the cutting edge (5 or 8) and preferably the entire blade body (3 or 6) is formed of a heat-treated steel, a high-speed steel, or a tool steel, in particular a cold-worked steel.

4. The blade according to one of claims 1 to 3, characterized in that the foreign ions are of nitrogen, carbon, molybdenum, tungsten, and/or titanium.

5. The blade according to claim 4, characterized in that the portion of foreign ions that are molybdenum or tungsten ions is smaller than the portion that is titanium ions.

6. An apparatus for longitudinally cutting a moving material web, in particular a paper or cardboard web or a plastic or metal foil with one or more pairs of circular blades each comprises of an upper blade (1) and a lower blade (2), characterized in that the upper blade (12) and/or the lower blade (2) is a circular blade with the features of one or more of claims 1 to 5.

7. An apparatus for transversely cutting a moving material web, in particular a paper or cardboard web with a blade drum that is fitted on its surface with one or more transverse blades extending a full length of the drum, characterized in that the transverse blade is formed according to one or more of claims 1 to 5.